

INTRODUCTION

In 1980 the U.S. Congress passed CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act), or Superfund. The idea was that with a few years and a finite amount of funding, the abandoned waste sites in the United States could be cleaned up. The magnitude and complexity of the problem were vastly underestimated. Clean-up strategies were not straightforward and technologies were not adequate to meet clean-up goals. In the mid-1980s Congress began developing new language for legislation to extend the scope of Superfund. On the basis of the inadequacies of the knowledge and technologies available, Congress chose to provide support for basic research. The intent was to improve the identification, assessment, and evaluation of the potential health effects of exposure to hazardous waste and to strengthen chemical, physical, and biological technologies available for remediating hazardous substances.

In 1986 the Superfund Amendments and Reauthorization Act (SARA) was passed and Congress under section 311(a) established the Superfund Hazardous Substances Basic Research and Training Program (Superfund Basic Research Program) as a university-based, grants program to be managed by the National Institute of Environmental Health Sciences (NIEHS), an institute of the National Institutes of Health (NIH). This program complements activities undertaken by the U.S. Environmental Protection Agency (U.S. EPA) and the Agency for Toxic Substances and Disease Registry (ATSDR) related to hazardous substances and human health and the environment. The mandates of the program are listed below.

The SARA legislation mandates that the research funded by this program should include development of

- Methods and technologies to detect hazardous substances in the environment
- Advanced techniques for detection, assessment, and evaluation of the effects on human health of hazardous substances
- Methods to assess the risks to human health presented by hazardous substances
- Basic biological, chemical, and physical methods to reduce the amount and toxicity of hazardous substances

The Superfund Basic Research Program is a unique program of basic research and training grants directed toward understanding, assessing, and attenuating the adverse effects on human health resulting from exposure to hazardous substances. Grants made under this program are for coordinated, multi-component, interdisciplinary programs. The program, now in its twelfth year, provides funding to 18 programs at 70 universities and institutions around the United States to study the human health effects of hazardous substances in the environment, especially those found at uncontrolled, leaking waste disposal sites. The program's primary objectives are to expand the base of scientific knowledge, reduce the amount and toxicity of hazardous substances, and ultimately, prevent adverse human health effects.

A primary goal of the Superfund Basic Research Program is to encourage true collaborative efforts among researchers to address the public health concerns associated with hazardous wastes in the environment. It is a singular program linking biomedical research with related engineering, hydrogeologic, and ecologic components, providing a broader and more detailed body of scientific information to be used by state, local, and federal agencies and by private organizations and industry in making decisions related to the management of hazardous substances.

A Multi-Disciplinary Symposium

This monograph contains 23 peer-reviewed papers based on presentations at the symposium "Superfund Basic Research Program: A Decade of Improving Health Through Multi-Disciplinary Research," which was sponsored by the NIEHS on 23–26 February 1997 and hosted by the University of North Carolina at Chapel Hill, North Carolina. The purpose of the meeting was to highlight the accomplishments of the program since its establishment in 1987. The national meeting brought together over 450 researchers in a show of diversity that mirrors the program itself: molecular biologists, hydrogeologists, epidemiologists, combustion engineers, toxicologists, ecologists, physiologists, clinicians, and community-based investigators.

Five plenary sessions formed the framework for the meeting: "Human-Based Decision Making," "Chlorinated Organics," "Metals, Risk Assessment, and Risk Reduction." The papers in this monograph have been grouped by plenary topic. They represent original research presented as plenary presentations as well as selected poster presentations. The resulting quality and types of papers presented in this monograph is a testimony to the original research being conducted on the subject of assessing, evaluating, and remediating hazardous substances on human health. Such a collection of investigators is seldom found in one place at one time. These papers also represent a significant contribution to the literature because they address the subject from multidisciplinary perspectives.

A Case for Basic Research

Basic fundamental research is critically important for the nation's remedial efforts. Research is needed to reduce the uncertainty in the decision-making process. Research is also needed in the development of better, cheaper technologies to improve the clean-up process. These efforts are important for reducing risk, preventing human and ecologic exposure to toxic wastes and reducing the cost of remediation. Ultimately, the protection of the nation's public health should be based on fundamental, mechanistically based research. This is the premise on which the Superfund Basic Research Program was established.

A unique feature of the program is that it fosters an interdisciplinary research approach to address the problems presented at hazardous waste sites. By encouraging health scientists to collaborate with engineers, ecologists or hydrogeologists, a holistic approach to

risk assessment and risk management of Superfund hazardous waste sites has been developed. Not only does this type of association between diverse researchers not occur within the normal university setting, there are no university-based programs funded by federal government agencies that support such multidisciplinary efforts as these. This program is an outstanding model for addressing complex environmental issues.

The program has advanced the infrastructure of the environmental health sciences. Presently, it includes 18 universities encompassing 69 collaborating institutions throughout the country, each with an established research program in environmental sciences. These scientists are on the forefront of environmental health research and are active contributors to the field. Over 500 publications per year are being published in peer-reviewed journals as a result of support from this program. These efforts are not trivial; each publication contributes to the knowledge and understanding of the field of hazardous waste. Equally as important, when viewed in total, the research findings have advanced the entire discipline of environmental health in context of hazardous substances. This university-based grants program also includes both predoctoral and postdoctoral training in both health and environmental technology areas. These trainees will be the future leaders and contributors in the environmental health science arena.

Information/Technology Transfer

This symposium was an excellent vehicle for fostering multidisciplinary research by bringing together investigators from diverse scientific disciplines to discuss their research. The diversity of the research covered at this 2 1/2-day symposium provided those in attendance with a better understanding of the complexities of environmental science and an appreciation of how the Superfund Basic Research Program contributes to improved strategies for managing U.S. hazardous waste sites.

A premise of basic research is that it is an investment; results are not immediate. Research is followed by development and application, and then commercialization. In scientific areas such as engineering, geology, or hydrogeology in which basic research has a more direct link to commercialization of a product or process, the Superfund Basic Research Program has had many successes in bringing basic science to field application. This symposium demonstrated direct technologic applications making substantial contributions to the effective remediation of hazardous waste sites. Significant contributions have also been made in the understanding of both phenomenologic and mechanistic effects of hazardous substances on cellular and molecular process. Great strides have been made in taking basic research forward to develop biomarkers that are integral to the application of molecular epidemiologic approaches to improve the predictive power of classic epidemiology studies. Beyond the papers and posters presented in this monograph, there are potentially hundreds more successes within this Superfund program. A challenge facing the NIEHS program is

how best to bring forth the tremendous knowledge gained by our researchers in a form useful to the many "stakeholders" of the program. To do this, NIEHS interacts and coordinates the program's activities with the U.S. EPA, ATSDR, and other agencies and organizations, both public and private, to allow for the timely transfer of technologies and information. This symposium sought to strengthen these ties by including the U.S. EPA and ATSDR staff on the steering committee and as active participants. It is because of efforts such as these that the Superfund Basic Research and Training Program is a unique and productive basic research program contributing to the immediate and practical resolution of the complex problems of hazardous waste management.

Considerations about the Future

Superfund sites and other hazardous waste sites can potentially affect everyone. The effects may be in the form of health effects, degradation of the environment or on the economy of a community. Children and future generations are especially vulnerable to the undesirable effects of exposures to hazardous substances. Far-reaching benefits from the research conducted by this program are now being realized. This monograph demonstrates that the basic research supported by this Superfund program for the last decade has not only advanced the science of identifying, assessing, monitoring, and remediating hazardous waste, but more important, it is affecting the health of the community. Basic research is an investment in the future and should be a priority.

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